PRELIMINARY DEVELOPMENT AND VALIDATION OF THE WHEELCHAIR PARTS QUESTIONNAIRE FOR USE TO ASSESS THE CONDITION OF INDIVIDUAL WHEELCHAIRS AND THE DESIGN OF TYPES OF WHEELCHAIRS

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ABSTRACT

Manufacturers providing wheelchairs for low resource settings are interested in clinician-reported outcomes on the design and durability of their chairs. Development of the Wheelchair Parts Questionnaire (WPQ) was initiated to provide a tool enabling clinicians to rate the key structural regions of a wheelchair. As an aspect of two long term field studies, the questionnaire was used by one experienced clinician to assess the maintenance condition of each individual study wheelchair after a period of use. It was also used by group of clinicians to assess the design of four types of wheelchairs intended for use in low-income countries. Preliminary data indicates that the WPQ was able to differentiate in a significant and meaningful way between the various types of wheelchairs and to provide statistically robust descriptive data useful to the manufacturers. Test re-test reliability and initial construct validation is planned for 2013.

BACKGROUND

In low income countries, there is an unmet need for assistive devices such as wheelchairs which are necessary for those with mobility impairments to participate fully in society (Authier, Pearlman, Allegretti, Rice, & Cooper, 2007). Outcomes research provides important sources of feedback which can be used to facilitate design and condition improvements when relayed back to the manufacturers of the assistive devices (Borg & Khasnabis, 2008). While many wheelchairs are provided with good intentions, wheelchairs donated to low income countries do not always meet high quality standards such as durability and good design (Eide & Øderud, 2009). Over the last fifteen years, organizations have increasingly been attempting to design wheelchairs for low resource settings; most of these are provided as a somewhat adjustable seating system and base as a unit (Jefferds et al., 2010).

The design and condition of a wheelchair are known to impact its functionality (Gorce, 2012; Hosseini, Oyster, Kirby, Harrington, & Boninger, 2012). Wheelchair assessment questionnaires currently available seem to be primarily tailored to assess the functionality of a wheelchair for a particular user, producing either qualitative or categorical data (Batavia, 2009; Karmarkar & Cooper, 2009). In contrast, a visual analogue scale (VAS) format questionnaire often produces continuous data, avoiding possible clumping or loss of data (Sherman, Eisen, Burwinkle, & Varni, 2006).

PURPOSE

Our purpose was to provide quantitative professional report outcomes to those providing and manufacturing wheelchairs in low-resource settings. We hypothesized that a VAS format questionnaire, based on a list of key regions of wheelchair structure, would enable clinicians to provide meaningful and statistically normal quantitative data that could be analyzed using sensitive parametric statistics.

1. The Wheelchair Parts Questionnaire utilized for design (WPQd) with accessory Wheelchair Design Likelihood (WDL) questions would provide data on the design of a type of wheelchair.
2. The Wheelchair Parts Questionnaire utilized for condition (WPQc) would provide data on the condition of the parts of individual wheelchairs after a period of use.

METHODS

Initial Development

As mentioned earlier, existing wheelchair assessment protocols seemed either to be qualitative, or to provide categorical data and to be aimed at assessing a particular chair for a particular individual. These seemed unsuited for our purpose because of length, focus and non-parametric nature of data produced. Therefore, based on input from seating specialists and from textbooks, the WPQ was developed based on eleven structural regions of a wheelchair (Table 1) (Batavia, 2009).

Table 1. Parts of the wheelchair included in the WPQ

seat back	frame
seat	wheels and push rims
head support	wheel locks
uprights/handles	castors
back and hip supports	lap belt
front rigging and foot support	overall

The WPQ for condition (WPQc) had initial instructions indicating that each part of an individual wheelchair was to be assessed for its maintenance condition.

Questions stated, “Rate the current maintenance condition of the (part in question)”.

The WPQ for design (WPQd) had initial instructions indicating that each wheelchair part was to be assessed for the functionality of a type of wheelchair. Questions stated “Rate the design of the (part in question)”. The seven accessory WDL questions asked the clinicians to rate the likelihood that the type of wheelchair would serve well in different conditions of use (table 2).

Table 2. WLQ questions: "rate the likelihood this type of wheelchair will

have overall good durability
function well in less-resourced settings
allow the user to avoid pressure sores
enable school or work
enable play or recreation
serve well for someone who needs lateral support
serve well for someone who can actively self-propel

The questionnaires made use of a VAS format developed as we were modifying and validating the Functional Mobility Assessment questionnaire for use with children (Rispin, Schein, & Wee, 2013). We knew that all of the clinicians who would be participating in our studies spoke English well, but for some of them it was a second language. In this cross-cultural setting, we desired a simple format to obtain reliable data. To that end, we included emoticons as anchors at either end and “Grades” as anchors below the continuous scale. Quantitative explanatory data was also solicited. Following each VAS question, two comment lines provided space for clinicians to remark positively and negatively on features of the region of the chair specified by the question.

Preliminary validation

This was done as part of a set of long term comparative studies that also included user report and performance assessment. The WPQc and WPQd with WLQ served as the professional report aspect of these field studies done in partnership with a boarding school for children with disabilities in Kenya. These studies enabled the provision of two batches of study wheelchairs and facilitated training for the clinicians caring for the children. Ethics approval was obtained from all involved organizations.

Wheelchairs: In 2011, the study involved two types of pediatric wheelchairs with 12 inch wide seats, and in 2012 two types of pediatric chairs with 14 inch wide seats (Table 3).

WPQc: At the end of each field study, after a period of use, the maintenance condition of each study chair was assessed by an ATP certified wheelchair specialist with more than 20 years of pediatric experience.

WPQd and WLQ: In 2011 and again in 2012, a group of clinicians each rated the design of each type or makes of wheelchair in that year’s study. Seven additional wheelchair design “likelihood” (WDL) questions were appended to the WPQd. With these, clinicians rated the likelihood that the design of a make of wheelchair would serve under different conditions of use. In 2011 there were 10 clinicians who completed the WPQd and WLQ for the two types of chairs in that years study (1 American, 1 Canadian, 8 Kenyans). In 2013 there were 14 clinicians who participated (5 American, 1 Canadian, 8 Kenyans).

Statistical analysis included descriptive analysis and comparative analysis. Data was tested for normality using the Shapiro-Wilks test. Two-way within subjects ANOVA analysis with post hoc t-tests was utilized for the WPQd and WLQ with the clinicians who assessed the design of each make of chair as subjects. Two-way between subjects ANOVA analysis with post hoc t-tests was utilized for the WPQc with the individual wheelchairs assessed as subjects.

PRELIMINARY RESULTS

In 2011 and in 2012, the VAS format provided statistically normal data enabling robust descriptive statistical analysis. For example, in 2012 the WPQd indicated that clinicians gave poor ratings to the design of the foot plate and front rigging for both types of study chairs.

In 2011 and in 2012, comparative ANOVA analysis of WPQ data enabled professional report comparative outcomes. Two-way within subjects ANOVA analyses indicated significant differences in the design of the makes of study wheelchairs. Two-way between subjects ANOVA indicated significant differences in the condition and therefore the durability of the makes of study chairs. One type of study wheelchair consistently outperformed the other in both design and maintenance condition after a period of use, though different aspects of the lower rated wheelchair were revealed in the two studies. Questions involving parts of the wheelchair which had been removed on many of the individual study chairs were not included in the ANOVA analysis for WPQc.

DISCUSSION

It does seem that the two questionnaires highlight different aspects of wheelchair structure. For example, one of the study chairs in 2012 had very poor condition ratings for the wheels, but that problem had not been apparent when looking at the design of a new chair. What will break is not always obvious to experienced clinicians looking at the design of a type of wheelchair. It seems to us that this can only be revealed by assessing individual chairs after a period of use.

Initial validation is supported by the positive response of the clinicians and by the broadly accepted understanding that the condition and design of wheelchair

parts impact wheelchair function. The positive response of the manufacturers also confirms face validation. Preliminary data from 2011 and 2012 has been presented to the manufacturers who have indicated that they are responding with design improvements.

It seems to us that the simple straightforward content of the WPQ could be used to assess an individual chair for an individual user, and validation for a WPQ for assessment (WPQa) might also be pursued. Anecdotally, one experienced clinician independently has chosen to use it for that purpose.

Further development and validation of the WPQ is underway based on feedback from clinicians: Questions regarding parts that may be absent have been moved to the end of the questionnaire. Questions regarding headrest and laterals have been merged. An additional question has been added regarding the wheelchair tray. Another question has been added to the WLQ regarding the likelihood that the type of chair can be maintained in the setting where it is to be used.

For the WPQc and the WPQd with the WLQ, test re-test reliability and possible construct validation is planned for 2013.

Study limitations

The uneven number of types of study wheelchairs in 2011 (20/15) and in 2012 (25/10) was not ideal for two-way between subjects analysis for the WPQc. There was also wide variation in the maintenance condition of different individual wheelchair due partly to the different capabilities of their users. We selected options for ANOVA analysis which do not assume equal variance. In 2012, the low number of one make of study wheelchair resulted in lower but still acceptable statistical power. The high variation between the experience of the clinicians and the relatively low number of subjects, 10 in 2011 and 14 in 2012, was not ideal for producing equal variation in the results for the WPCd and WDL. However within subjects analysis reduced the impact of individual variation and produced sufficient statistical power for meaningful comparative analysis.

CONCLUSION

The ability of the WPQ to produce data that is of interest to providers and manufacturers gives initial confirmation that this simple straightforward questionnaire based on the parts of a wheelchair may add a useful professional report analysis tool.

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